

Evaluation of mutagenic and antimutagenic potential of stem bark aqueous extracts of eight trees by the bacterial reverse mutation assay

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Abstract

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Keywords

Ames test, Antimutagenicity, Medicinal plants, Mutagenicity, *Salmonella typhimurium* strains, Stem bark extracts

References

- [1] Craig WJ. Health-promoting properties of common herbs. *Am J Clin Nutr.* 1999;70(3):491S-499S. doi: 10.1093/ajcn/70.3.491s.
- [2] Junior VF, Pinto AC, Maciel MA. Plantas medicinais: cura segura? *Quim Nova.* 2005;28(3):519-528. doi: 10.1590/S0100-40422005000300026.
- [3] Farnsworth NR, Akerele O, Bingel AS, et al. Medicinal plants in therapy. *Bull World Health Organ.* 1985;63(6):965-981.
- [4] De Flora S, Ferguson LR. Overview of mechanisms of cancer chemopreventive agents. *Mutat Res.* 2005;591(1-2): 8-15. doi: 10.1016/j.mrfmmm.2005.02.029.
- [5] Bhattacharya S. Natural antimutagens: A Review. *Res J Med Plant.* 2011;5(2):116-126. doi: 10.3923/rjmp.2011.116.126.
- [6] Sangwan S, Shanker S, Sangwan RS, Kumar S. Plant-derived products as antimutagens. *Phytother Res.* 1998;12(6):389-399. doi: 10.1002/(SICI)1099-1573(199809)12:6<389::AID-PTR327>3.0.CO;2-S.
- [7] Karamova NS, Fatykhova DG, Abdrakhimova JR, Ilinskaya ON. An investigation of antigenotoxic properties of plant extracts of *Chelidonium majus* L., *Plantago major* L. and *Tussilago farfara* L. *Russian Journal of Genetics: Applied Research.* 2011;1(5):371-378. doi: 10.17816/ecogen8256-65.

- [8] Karamova N, Gumerova S, Hassan OG, et al. Antioxidant and antimutagenic potential of extracts of some Agavaceae family plants. *Bio Nano Science*. 2016;6(4):591-593. doi: 10.1007/s12668-016-0286-x.
- [9] Srividya AR, Dhanabal SP, Vishnuvarthan VJ. Mutagenicity/Antimutagenicity of plant extracts used in traditional medicine: a review. *World J Pharm Res*. 2012;2(1):236-259.
- [10] Maron DH, Ames BN. Revised methods for the *Salmonella typhimurium* mutagenicity test. *Mutat Res*. 1983;113(3-4):73-215. doi: 10.1016/b978-0-444-80519-5.50011-0.
- [11] Mortelmans K, Zeiger E. The Ames *Salmonella/microsome* mutagenicity assay. *Mutat Res*. 2000;455(1-2): 29-60. doi: 10.1016/S0027-5107(00)00064-6.
- [12] Ong T, Whong WZ, Stewart JD, Brockman HE. Chlorophyllin: a potent antimutagen against environmental and dietary complex mixtures. *Mutat Res*. 1986;173(2):111-115. doi: 10.1016/0165-7992(86)90086-2.
- [13] Negi PS, Jayaprakasha GK, Jena BS. Antioxidant and antimutagenic activities of pomegranate peel extracts. *Food Chem*. 2003;80(3):393-397. doi: 10.1016/S0308-8146(02)00279-0.
- [14] Ikken Y, Morales P, Martinez A, et al. Antimutagenic effect of fruit and vegetable ethanolic extracts against N-nitrosamines evaluated by the Ames test. *J Agric Food Chem*. 1999;47(8):3257-3264. doi: 10.1021/jf990166n.
- [15] Eldeen IMS, van Staden J. In vitro pharmacological investigation of extracts from some trees used in Sudanese traditional medicine. *S. Afr. J. Bot*. 2007;73(3):435-440. doi: 10.1016/j.sajb.2007.03.009.
- [16] Pandey S, Agrawal RC. Clastogenic analysis of *Bauhinia variegata* bark extract using micronucleus assay in mouse bone marrow cells. *American-Eurasian Journal of Toxicological Sciences*. 2010;2(2):112-114.
- [17] Yim M, Sarma BP, Sinha S, et al. Exploring the possible mechanism of *Albizia lebbek* components binding with drug targets of bronchial asthma - an in silico and clinical analysis. *Int J Pharm Sci Res*. 2014;5(11):5040-5049. doi: 10.13040/IJP-SR.0975-8232.5(11).5040-49.
- [18] Kada T, Inoue T, Namiko N. Environmental desmutagens and antimutagens. In: *Environmental mutagenesis and plant biology*. Ed by E.J. Klekowski. New York: Praeger; 1982. P. 137-151.
- [19] De Flora S. Mechanisms of inhibitors of mutagenesis and carcinogenesis. *Mutat Res*. 1998;402(1-2): 151-8. doi: 10.1016/S0027-5107(97)00292-3.
- [20] Watanabe M, Ishidate M Jr, Nohmi T. Sensitive method for detection of mutagenic nitroarenes and aromatic amines: new derivatives of *Salmonella typhimurium* tester strains possessing elevated O-acetyltransferase levels. *Mutat Res*. 1990;234(5):374-348.
- [21] Hagiwara Y, Watanabe M, Oda Y, et al. Specificity and sensitivity of *Salmonella typhimurium* YG1041 and YG1042 strains possessing elevated levels of both nitroreductase and acetyltransferase activity. *Mutat Res*. 1993;291(3):171-180. doi: 10.1016/0165-1161(93)90157-11
- [22] Paul TJ, Scheepers M, Straetemans ME, Koopman JP, Bos RR Nitroreduction and formation of hemoglobin adducts in rats with a human intestinal micro-flora. *Environ Health Perspect*. 1994; 102(6):39-41. doi: 10.1289/ehp.94102s639.
- [23] Suzuki M, Matsui K, Yamada M, et al. Construction of mutants of *Salmonella typhimurium* deficient in 8-hydroxyguanine DNA glycosylase and their sensitivities to oxidative mutagens and nitro compounds. *Mutat Res*. 1997;393(3):233-246. doi: 10.1016/S1383-5718(97)00108-3.
- [24] Purohit V, Basu A. Mutagenicity of nitroaromatic compounds. *Chem Res Toxicol*. 2000;13(8):673-692. doi: 10.1021/tx000002x.
- [25] Kleinhofs A, Smith JA. Effect of excision repair on azide-induced mutagenesis. *Mutat Res*. 1976;41(2-3): 233-240. doi: 10.1016/0027-5107(76)90096-8.
- [26] Veleminsky J, Angelis KJ. Effect of sodium azide on replicative and repair DNA synthesis in barley embryos. *Mutat Res*. 1987; 190(2): 15-129.
- [27] Owais WM, Kleinhofs A. Metabolic activation of the mutagen azide in biological systems. *Mutat Res*. 1988; 197(2):313-323. doi: 10.1016/0165-7992(87)90043-1.
- [28] Al-Qurainy F, Khan S. Mutagenic effect of sodium azide and its application in crop improvement. *World Applied Sciences Journal*. 2009;6(12): 1589-1601.
- [29] La Velle JM, Mangold JB. Structure-activity relationships of the azide metabolite, azidoalanine, in *S. typhimurium*. *Mutat Res*. 1987;177(1):27-33. doi: 10.1016/0027-5107(87)90018-2.
- [30] de Mejia EG, Castano-Tostado E, Loarca-Pina G. Antimutagenic effects of natural phenolic compounds in beans. *Mutat Res*. 1999;441(1):1-9. doi: 10.1016/S1383-5718(99)00040-6.
- [31] Martinez CJ, Loarca-Pina G, Ortiz GD. Antimutagenic activity of phenolic compounds, oligosaccharides and quinolizidinic alkaloids from *Lupinus campestris* seeds. *Food Addit Contain*. 2003;20(10):940-948. doi: 10.1080/02652030310001605998.
- [32] Pedreschi R, Cisneros-Zevallos L. Antimutagenic and antioxidant properties of phenolic fraction from Andean purple corn (*Zea mays* L.). *J Agric Food Chem*. 2006;54(13):4557-4567. doi: 10.1021/jf0531050.
- [33] Geetha T, Saini A, Kaur IP. Ginseng extract exhibits antimutagenic activity against induced mutagenesis various strains of *Salmonella typhimurium*. *Indian J Exp Biol*. 2006;44(10):838-841.

- [34] Geetha T, Garg A, Chopra K, Kaur IP. Delineation of antimutagenic activity of catechin, apecatechin and green tea extract. *Mutat Res.* 2004;556(1-2):65-74. doi: 10.1016/j.mrfmmm.2004.07.003.
- [35] Santos-Cervantos ME, Ibarra-Zazueta ME, Loarca-Pina G, et al. Antioxidant and antimutagenic activities of *Randia echinocarpa* fruit. *Plant Foods Hum Nutr.* 2007;62(2):71-77. doi: 10.1007/s11130-007-0044-x.
- [36] Kumar VC, Nagarathna PKM, Kulakarni SC, Sai-nadh NS. Evaluation of antimutagenic effect of flavonoid of *Kigelia africana* on Swiss-Albino Mice. *Int J Pharm Sci Rev Res.* 2013;21(1): 105-108.
- [37] Sharma N, Bhardwaj R, Kumar S, Kaur S. Evaluation of *Bauhinia variegata* L. bark fractions for in vitro antioxidant potential and protective effect against H-induced oxidative damage to pBR322 DNA. *Afr J Pharm Pharmacol.* 2011;5(12): 1494-1500. doi: 10.5897/AJPP 11.457.